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Case Study

Risk Management: Pricing, Insurance, Guarantees

Agricultural Insurance in Latin America: Where Are We?

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1. Introduction

1.1 Importance and Relevance of Insurance

This paper reviews the weaknesses of traditional crop insurance programs and highlights new developments, especially as they regard Latin America, that hold promise of making agricultural insurance more accessible, more efficient, and more sustainable.

Risk is an unavoidable but manageable element in the business of agricultural production and marketing. Agricultural production can vary widely from year to year due to unforeseen weather, disease/pest infestations, and/or market conditions causing wide swings in yields and commodity prices. Table 1 provides a list of the types of risks common in agriculture. These wide swings in yields and output prices generate high variability in farmer household income. The uncertainty in future incomes complicates both short-term production and long-term planning, that is, whether to expand or reduce production, whether to invest in acquisition of fixed and moveable assets, whether to stay in farming or to exit. When the swings significantly reduce income in the short-term, there can be serious repercussions in the absence of effective risk management tools, especially when those swings are systemic shocks to the whole sector. The negative shocks, for example, can affect farmer's ability to repay financial obligations and lead to a loan default. Lending institutions may then be less inclined to extend loans to this sector in general due to high probability of loan default. The inability to easily access external financing over times limits farmer's abilities to expand, diversify, and modernize.

Table1.

Agricultural Risks		
CLIMATIC	Hail, frost, drought, flood, wind, fire, snow, ice, etc.	
SANITARY	Plagues and diseases	controllable
		not controllable
GEOLOGICAL	Earthquakes, volcanic eruptions, etc.	
MARKET	Domestic and international prices variability and changes in quality standards	
MAN MADE	War, financial crisis, collapse of legal institutions, etc.	controllable
		not controllable

Source: Zorilla (2002)

In order to mitigate the inherent risks common to agriculture, farm operators have to use an array of risk management strategies and techniques such as: (1) crop diversification, (2) maintaining financial reserves, (3) reliance on off-farm employment and income generation, (4) production contracting, (5) marketing contracting, (6) forward pricing, (7) futures options contracts, (8) leasing inputs and custom hiring (9), and (10) acquiring crop and revenue insurance. Unfortunately, many of the more modern risk management tools (items 4-10) are not widely available or accessible in developing countries. In order for modern risk management techniques to materialize, certain market and supply conditions have to be met and appropriate infrastructure, legal/regulatory as well as physical, must be in place. Unfortunately in developing countries, many of these conditions are missing or incomplete, forcing farm operators to depend more on private,

on-farm strategies (items 1-3) that inhibits the achievement of economies of scale in production, lowers productivity, and ultimately reduces farm profits in the long-run. In contrast, when crop insurance is combined with forward pricing strategies it has been proven to be very effective in reducing both production and price risk for farm operators in developed countries (Makki, 2002). Neither technique, however, is widely available in developing countries. Why is this so?

1.2 Classic Problems with Delivery of Insurance

Agricultural crop insurance is simply a difficult product to produce. Private agricultural insurance has tended not to appear due to market and government failures for the following reasons.

First, private insurers have not been able to cope with systemic, non-diversifiable risk in crop yields stemming from say natural disasters affecting a large number of farms over a widespread region. Even with the possibility of reinsurance it is hard to calculate fair premiums in order to develop sufficient reserves for low probability but high loss events. Portfolios of geographically dispersed crop insurance contracts can be as much as 20 times more risky than an equally valued portfolio of health and automobile insurance contracts.

Second, the presence of asymmetric information, which can lead to adverse selection and moral hazard problems, raises the cost and risks of introducing crop insurance products more so than other types of insurance products. Adverse selection in insurance markets refers to the situation where insurers find it impossible or very expensive to distinguish between high-risk and low-risk insurance applicants and thus prices insurance contracts at the average premium for all individuals, which is inappropriate and non-sustainable. This results in undercharging high-risk customers and overcharging low-risk customers for identical contracts. Over time the low-risk clients drop out of the market and the insurance company is left with a very high-risk pool of clients with higher expected indemnities that negatively affects insurer's profitability. Moral hazard refers to the situation where the granting of an insurance contract can lead to a reduction in the application of good husbandry practices or the complete altering of production practices on the part of the client, resulting in higher loss claims.

These two problems affect all insurance markets but more so in agricultural ones because obtaining information on clients is more difficult and monitoring client behavior is more costly. Because of the geographic dispersion of clients in rural areas and the highly differentiated production characteristics of each farm, the administrative costs of effectively monitoring effort and differentiating between "legitimate" and fraudulent loss claims can be prohibitive. If the "coverage of loss" is set too low, on the other hand, to discourage carelessness and negligence, the market can be become very thin and the advantages gained by pooling risk types, the essence of insurance intermediation, is lost. As a result of these two incentive problems—adverse selection and moral hazard—

private insurance is generally not available, and if it is available, it is not affordable to the majority of farm operators.

Historically, private crop insurance in developed countries has been limited to single peril products, namely, rain/hail insurance, for which it is possible to set actuarially sound premiums and easy to verify damages and losses. Government has used the inability of private insurers to offer affordable insurance products, especially in the multiple peril and catastrophic loss insurance market segments, as a justification to enter as a direct or indirect insurance provider. The experience of government-backed programs generally has not been positive in terms of economic soundness but area coverage has been good.[1] The government programs have been characterized by high actuarial losses and high subsidy outlays.

The model of crop insurance followed in a number of high-income countries, such as the U.S. Spain, France, and Italy is for the central government to provide: (i) subsidies on premiums to farmers; (ii) operational subsidies to private insurers to cover some of the high administrative costs associated with agricultural insurance contract underwriting; and (iii) subsidized reinsurance. Moreover, once government insurance programs exist, it is difficult for private companies to innovate and introduce new risk management products. On the positive side, government–backed insurance programs have served as a substitute means of transferring payments to farmers and maintaining farm income levels in a post-Uruguay Round of Trade Negotiations policy regime wherein all signatories to the agreement are suppose to reduce and phase out direct support payments to farmers. To replicate the reigning model of crop insurance found in developed countries in a developing country context, characterized by recurrent public deficits and extreme concern with managing inflation and rationalizing public expenditures, would be imprudent and ill advised.

In summary, traditional agricultural insurance programs are financial failures because of high administrative costs and unresolved, adverse selection and moral hazard problems. As can seen in the Table 2, up until now, no agricultural insurance program in the world has been able to fully cover their own indemnity payments (I) and administrative costs (A) with the collected premiums (P).

Table 2.
Agricultural Insurance Programs - Costs vs.

[1] The percentage of total area cultivated that is insured in selected developed countries are as follows: US-45.89%, Canada-54.73%; Spain-42.52%; and Japan-79.31% in 2000. Source: Agroasemex .

Premiums		
Country	**Time Period**	**(I + A) / P**
Brazil	1975-81	4.57
Costa Rica	1970-89	2.80
Japan	1947-77	2.60
	1985-89	4.56
México	1980-89	3.65
Philippines	1981-89	5.74
USA	1980-89	2.42
	1999	3.67

Source: Skees (2003)

Further complicating the matter, governments, and the international donor community, often times decide to intervene with *post hoc* income risk management assistance when the agricultural sector receives a traditionally uninsured sudden systemic shock. In theory, such aid should help mostly the uninsured poor by directly transferring resources to their adversely affected household income. However, in practice this does not happen, since disaster assistance usually comes in the form of debt forgiveness and the rural poor are not able to borrow in the first place. Another factor hindering the development of agricultural insurance products is that most *post hoc* disaster assistance is free.

Households grow to expect government compensation for sudden systemic losses (mostly natural disasters), which directly affects the willingness to pay for insurance. However, this is not the most important problem, as free disaster assistance may be well needed after all. It is the nontransparent and nature of the assistance that creates more risks in the decision making of producers. Disaster assistance rules must be made explicit in order for producers to more accurately estimate the real cost of the risk they face and make an informed decision on the purchasing of agricultural insurance.

1.3 Innovations in Agricultural Insurance

Recent financial and technological innovations in the insurance markets could provide alternatives for dealing with agricultural risks, especially as it relates to climatic risk. Capital markets can be part of the financial solution to making agricultural insurance more accessible to producers (Skees et al., 2002b). While risk-swapping and risk-sharing markets have been evolving for some time in the form of catastrophe bonds, insurance contracts, and weather market derivatives, the recent increase in natural disaster losses suffered by insurers and reinsurers has escalated the development of such instruments.

Most of these new, innovative instruments are tied to the performance of some statistic (index) where the probability distribution can be estimated and the event measured. Moreover, technological innovations such as weather-measuring satellites, satellite imagery, ground level real-time weather and early warning computer models (LEWS), have also helped eliminate some of the high cost barriers to agricultural insurance. This parametric quality of index-based instruments and the technological innovations have greatly reduced and/or eliminated most of the traditional problems faced by agricultural

insurance, such as moral hazard, high transaction costs, adverse selection, and information asymmetries.

We can divide these innovative agricultural insurance instruments into two main types: weather index and area-yield index. Weather-based index contracts establish indemnity payments based on the occurrence of a pre-specified climatic event(s) such as temperature, rainfall, wind speed, etc., in a pre-specified area. Area-yield-based index contracts establish indemnity payments based on average area yields in a pre-specified area. This area is usually at a county level and the contract is set up whereas if the average county yield for a given agricultural product (crop or livestock) falls bellow a certain level, indemnity payments are triggered to the holder of the contract. In section 3 there is a detailed discussion on the virtues and weaknesses of these new instruments as well as the necessary conditions and supporting institutions.

2. Historical Overview and Lessons Learned

2.1 Experiences of Developed Countries

USA

The U.S. crop insurance market has been in existence for approximately 100 years. Private sector insurers have provided single peril insurance products (hail, fire, flood, frost, wind, etc) efficiently and profitably for a long time. Multiple peril insurance has largely been provided directly by the U.S. government or backed by the U.S. government since a reform in 1994. Up until 1994, U.S. Department of Agriculture (USDA) delivered most of the multiple peril crop insurance but it was a largely underdeveloped market because extensive commodity support programs and ad hoc disaster bailouts dating back to the 1930s reduced the incentives for farmers to participate in government supported multiple peril insurance schemes. However, with reforms in insurance programs in 1994 and the Farm Bills of 1996 and 2000, incentives changed. Now private insurance companies, backed by government reinsurance facilities, premium subsidy payments to farmers, and administrative and operational cost subsidies, are the dominant providers of multiple peril insurance. The acreage covered by insurance has more than doubled compared to early 1990s levels. In 2000, over 200 million acres were covered compared to 80 million in 1992. Total cultivated area was approximately 500 million acres.

Two broad categories of insurance products are offered, yield and revenue. Within the yield category there are three specific products: actual production history, catastrophic, and group risk plan. Within the revenue category are four specific products: crop revenues, revenue assurance, income protection, and dollar revenue insurance. Four major crops (corn, wheat, soybeans, and cotton) are covered and accounted for 75% of risk premiums paid in 2001.

The efficiency, equity, and cost effectiveness of the U.S. program are not good. The total cost to the government in 2001 was $2.5 billion. Premium subsidies are increasing. In

2001, the premium subsidies amounted to $1.8 billion up from $700,000 in 1992. The subsidies paid to private insurance companies, has jumped to $648 million from $225 in the same period. Loss ratios (indemnities paid out / premiums paid in) have been persistently above one (the breakeven point) for most states and all crops for the last 20 years. Moreover, the benefits are concentrated. There are approximately 3 million farmers but only a small fraction, 300-400,000, participate in government backed insurance schemes. Those who participate tend to be large, highly educated, and well-capitalized farmers. Low-income, small-scale, and specialty crop producers are largely excluded.

What can we learn from the US experience? First, we can conclude that the U.S. program lacks clear objectives and is subject to political rent seeking. It has drifted from a risk management tool to largely a disaster management and now to an income maintenance tool. Some argue that it is a disguised way of transferring income in a post-Uruguay GATT / WTO regime. There are flaws in design (e.g. yield averages are used instead of variance, premiums are not actuarially sound, and changes from year to year are modest due to political considerations). The desire to provide multiple peril insurance to satisfy the powerful farm grain lobbies increases costs to the treasury significantly.

Second, we can conclude that the implementation is less than ideal. The cost of delivery is high. There are reported moral hazard problems and fraud problems. Lastly, private insurance companies do not bear their fair share of risks given the high levels of operational subsidies paid and the generous reinsurance mechanisms. In addition to the lack of cost effectiveness, government insurance programs crowd out private insurance products, and change farm production and management practices, affecting the cropping mix shifting production towards those crops under the insurance program[2].

Spain

Spain due to its topography and location, at the meeting point of two weather systems one originating in the Atlantic Ocean and the other in Mediterranean Sea, has very variable rainfall and climate patterns. Since 1978, it has a developed a mixed public-private crop insurance scheme, wherein the government, through a specialized agency affiliated with the Ministry of Agriculture, Fisheries, and Food, State Agency for Agricultural Insurance (ENESA), conducts studies, designs new insurance products, provides reinsurance, pays a fraction of farmer premiums, and provides operational subsidies to private insurers who actually sell the products.

The aim of the current insurance program is to have close to universal coverage as possible. To date about 42% of cultivated area is insured. The risks covered are hail, fire, wind, flooding, droughts, heat waves, diseases due to climatic conditions (i.e. fungus infections), accidents, death, sacrifices of livestock, and economic losses due to several animal diseases. The principal crops and animals insured are vegetables (all types), cereals, legumes, tubers, industrial crops (cotton, sugar, tobacco), pastures, flowers,

[2] Ideally, insurance instruments should be available for all crops. By focusing on a few ones, insurance programs bias production decision towards those crops under coverage.

citrus, olives, several species of farm raised fish, cattle, sheep, pigs, horses, and goats. In the 2002 Insurance Plan, there were 65 insurance products/programs, including a program to insure the fixed costs of agricultural cooperatives that experience climate induced losses. In 1990, there were 36. ENESA actively coordinates with provincial governments and producer associations to adapt products to local conditions. As a result of the growing complexity, the annual cost to the State has risen from 74 million Euros in 1978 to 2.5 billion Euros in 2002. Indemnity payments cover between 65-100% of losses and historically indemnity payments plus administrative costs have exceeded premium payments. The main political rationale for the insurance program is stability in fiscal outlays. Because the insurance budget is planned every year and types of coverage are so extensive, ad hoc disaster payments and sharp drops in farm tax collections are avoided.

2.2 Experiences in Developing Countries

Uruguay

Agricultural insurance has been available in Uruguay for sometime, but at a very limited scale. Between 1913 and 1993, it was under state monopoly. The State Insurance Bank (Banco de Seguros del Estado) was the only entity permitted to issue policies. Since then only two private companies have entered the marketplace, offering single peril policies.

The limited coverage is due in part to an unofficial policy of virtually automatic post disaster relief from the Government. When farmers face climatic and market shocks, normally they mobilize and lobby the Government for assistance. Therefore, they have little or no incentive to purchase private insurance. In addition, the Banco de Seguros del Estado is perceived as not honoring its contracts. When a policy issued by the Banco de Seguros del Estado states that an indemnity should be paid, technicalities are used to reduce or delay payment. As a result, re-enrollment rates fall.

Since 2001, the Ministry of Agriculture has been trying to rationalize the system by undertaking studies to design a new, more rational insurance scheme to replace the present anemic private sector efforts and the very expensive and nontransparent “post disaster emergency payments and debt forgiveness” schemes. Spanish insurance companies are advising the Uruguayan government. A law is being proposed that would have the government subsidize up to 60% of farm premiums for a multiple peril policy that covers partial loss, introduce an area yield product, and to establish a separate catastrophic emergency disaster fund open to only those that purchase crop insurance. The major impediments are lack of a set of complementary and well coordinated supporting institutions, the lack of a clear legal and regulatory framework, and the need to develop a “new vision about how to handle agricultural risk”. On the positive side, Uruguay has long and reliable series of historical data on weather and agricultural production as well as a cadre of well-trained professionals in the subject matter.

Mexico

Mexico first agricultural insurance program dates back to 1942. The early attempts were mutualist arrangements and private insurance companies. In 1961, The Crop and Livestock Insurance Act was passed, formally establishing the State run National Crop and Live Stock Insurance Company (ANAGASA). ANAGASA began operations in 1963 and clients of state development banks, Banco Ejidal and Banco Agricola (late merged to form Banco Nacional de Credito Agricola - BANRURAL), were obliged to purchase crop insurance policies. The policies where multiple peril, premiums were subsidized and cultivated area insured was large. Unfortunately, due to lax monitoring, actuarially unsound pricing, and fraud (filing of false claims), losses for ANAGASA were staggeringly high. At one point, indemity payments represented 70% of the loan recoveries of BANURAL. The number of claims for indemnification were astoundingly high. Eventually, the fiscal cost was deemed unacceptable and ANAGASA was closed in 1988.

In 1991, a new government crop insurance company was formed AGROASEMEX. Unlike its predecessor, AGROASEMEX only reinsures local private insurance companies (only five offer crop insurance products) and about 200 mutual insurance funds (Fondos de Aseguramiento or FONDOS), serves a a technical adviser to the FONDOS, and manages the Federal premia subsidy program for the FONDOS. [3] The FONDOS tend to be in low-income regions of the country. The risks covered are drought, excess moisture, frost, hail, fire, wind, plant infestations, and livestock diseases, accidents, incapacity, and forced sacrifices. The products offered are for investments, expected yield, and greenhouses. Under this voluntary program, area insured has risen from 636,000 hectares in 1991 to 1.9 million in 2000. Similarly, livestock coverage has risen from 576,000 heads in 1991 to 9.7 million in 2000. The area, however, is much less than the area covered by its predecessor. In 2000, Agrosemex, insured 1.9 millon hectares out of a total of 21.9 million cultivated (8%). However, AGROASEMEX's program is more cost effective. For example, its ratio of indemnity to reinsurance averaged 13.06% for the period 1991-96 (Hernandez, 1997).

3. New Designs

3.1 Virtues of New Insurance Instruments

Innovative instruments have mostly focused on tackling the traditional problems with agricultural insurance like moral hazard, high transaction costs, adverse selection, and information asymmetries, but most importantly, have tried to deal with the problem of systemic shocks, especially climatic ones, to the agricultural sector. These innovative instruments are very promising for developing countries, since most of them have a high exposure to weather risks. Area-yield indexes deal with the classic problems faced by agricultural insurance, while weather indexes deal with the same classic problems as well as with the covariance component in climate-based shocks to agriculture as it has

[3] The FONDOS are mutual insurance funds that allow farmers to pool resources and insure themselves as a group.

substantial benefits in terms of reinsurance possibilities and access to external capital markets.

Area-Yield Index

Problems with traditional multi-peril crop insurance products are widely known. The typical problems such as moral hazard and adverse selection, are exacerbated in developing countries with relatively higher number of small-holder farmers, weak institutional capacity, weak infrastructure and a lack of information. These latter factors contribute to exceedingly high administrative costs. Area yield-based index contracts offer payouts when average area yield in a pre-specified area fall below a certain level. This area is usually at a county level or at a level large enough to avoid collusion and small enough to represent the physical and market conditions of any given individual farmer.

Thus, area yield insurance offers indemnity which does not depend on farm-level yield, which not only avoids problems of moral hazard, adverse selection, and high transaction costs, but it also creates the incentives for improving productivity at higher levels than the average area (county) yield in order to benefit further from any payout by the insurance. In other words, such index-based contracts foster competition among producers and encourages measures to mitigate any adverse effects to farm-level yield to be above the average in relation to county-level yield. In the case of the county-level yield falling below certain level and triggering indemnity payouts, farmers that had a higher than average farm-level yield will not only benefit from the payouts, but also from the relative higher revenues from higher than average yields.

However, this area yield index has to be measured by an independent party, which can be an obstacle in some cases. Also, in order to design such insurance contracts, accurate county yield history needs to exist, which is not always available. So an alternative that has been developed to overcome such problems of data reliability and data availability was to find another index that is highly correlated with area yields and farm yield, but that is easy to verify and where historical data exists at the county level. Weather variables such as temperature and rainfall, or satellite images of land cover (vegetation) fit the profile of such indexes and have a great potential to serve the needs of both producers and insurers.

Weather Indexes

The virtues of weather index insurance are the same as in the area-yield index, as discussed in the previous section. The importance of the weather insurance is that it focuses on the covariate nature of the climatic risk faced by rural producers in developing countries, as well as other sectors in the economy. Excess rain, droughts, frosts, and high winds are among the many relatively cheaply and objectively verifiable weather events that have a direct and systemic impact on the economic activities of the rural sector in general and of the agricultural sector in particular. These systemic risks affect particularly the poor who do not have the means to mitigate the impacts on their incomes and expenditures, not even through traditional risk coping mechanisms like mutual aid.

Thus, weather index insurance cannot only help mitigate the high risks faced by vulnerable households and economic agents within the rural sector, but also reduce government costs of natural disaster aid.

The reliance on climatic variables to set indemnity payouts provides an effective tool for transferring the systemic portion of the risk outside the region or country and tapping into capital markets to provide liquidity (Skees et al., 2001). Market instruments have been developed for managing catastrophic events as well as for less catastrophic events. The CAT bonds (catastrophe bonds) provide the opportunity for catastrophic insurance in light of hurricanes, floods, earthquakes, tornados, etc., while market instruments like temperature-based options provide risk management opportunities (swaps) and insurance for less catastrophic events. In section 3.3 we describe some of the experiences of developing countries with these types of instruments.

CAT bonds are a recent innovation that has the potential to make insurance for natural disasters more affordable and more accessible even in developing countries. CAT bonds are tradable financial assets that provide the holder with large amounts of capital contingent upon the occurrence of some catastrophic event. The coupons and principle payments on the bond depend on the performance of an index or pool of natural catastrophe risk, having the potential to be used as an indirect measure of agricultural losses. This means that the transaction is parametric, whereas the payments are tied to some statistic where the probability distribution can be estimated and the event measured. The bonds are usually offered by financers (special purpose reinsurers) who use the capital raised to offer reinsurance or insurance products to individuals facing and wanting to share the risk of losses from the catastrophic event. CAT bonds have been successfully implemented in the USA, Japan, and are being analyzed for implementation in developing countries.

Bringing together capital and reinsurance markets, as CAT bonds do, has been recently been looked at in face of the large losses suffered by insurers and reinsurers in the past few years in developed countries (Skees and Barnett, 1999, for a complete discussion on these trends). This bringing together of insurance and financial markets is also called "risk securitization" and has not only been a trend in developed countries but it is being explored as a risk sharing mechanism for the agricultural sector in developing countries (See Miranda and Vedenov, 2001, for a discussion on Nicaragua). The attractiveness of tapping into capital markets to share weather related risks are manifold: (i) weather related risks are uncorrelated with capital market movements, creating an attractive portfolio diversification instrument for investors; (ii) capital markets provide far more resources than there is available in insurance markets; and (iii) private capital reduces the cost of governments in terms of direct risk sharing for weather related risks.

Another innovative insurance instrument that can be used by agricultural producers, other than CAT bonds, are index-based weather derivatives, such as temperature-based options. These options are traded over the counter or in the Chicago Mercantile Exchange. The energy sector, who has a positive correlation between their income and temperature swings has launched these financial instruments and have created the opportunities for

other sectors who have a negative correlation between income and temperature swings, such as agriculture, to offset their losses (risk swapping). Another weather derivative that is being considered as having a great potential for agricultural insurance is rainfall-based indexes (See part 3.3 on Morocco).

Such innovative weather insurance instruments are highly attractive in terms of the amount of information and resources needed to design them. Traditional agricultural insurance need historical data on farm yield, data on farm yield for insured crop year, loss adjusters and compliance officers to supervise actual reported losses. Weather index insurance only need historical weather data and secure and objective weather measurements, as producers will choose their own coverage level according to the relation between their production losses and the weather event being covered by the insurance.

3.2 Necessary Conditions and Supporting Institutions

An important condition for the development of these innovative instruments, especially when looking into their introduction in developing countries, is suitable technology that allow monitoring and data collection to become more reliable, efficient, and accurate. One example of a technological innovation is the substitution of ground level, non-tamper free weather stations (costly to install and maintain), with satellite measuring weather technology and satellite imagery on vegetative cover. Another example is the ground level real-time weather technology and the early warning computer models. What most of these innovations in technology do is eliminate or reduce the risk of tampering with the data in which payments are based upon, as well as providing faster and more accurate information on specific weather events. For most developing countries, outdated and non-tamper free weather stations are a great obstacle for these innovative weather related insurance instruments to function.

The need for reliable historical data is also crucial to design weather index insurance instruments, which is another big obstacle in developing countries for the development of such innovative instruments. Another necessary condition for these innovative insurance instruments to prosper is the institutional support system. An important aspect, especially when dealing with weather related insurance, is the role, as mentioned in part 1.2, of disaster aid by national governments and international institutions. The inexplicit nature of such *post hoc* free disaster aid creates a negative incentive for weather insurance instruments to prosper, as agents will be factoring in the unknown probability of a bail-out in case of a weather related disaster. If the rules for payouts related to disaster aid would be made explicit, these could be taken into account in the designing of the weather insurance instruments. For this to happen, countries must have the institutional capacity to manage and plan in advance their response such natural disaster events.

Another condition for success is the means of institutional delivery. Weather-based insurance contracts could be sold to households, importers, governments, farmers, exporters, banks, etc. The function of such insurance instruments is the same for all institutional “clients” but efficiency could be gained by targeting different levels. For

example, instead of directly targeting farmers for insurance on their capital investments on their farms, such insurance instruments could be offered directly through banks that have a direct interest in lowering their agricultural sector portfolio risk, thus reducing transaction costs for farmers and insurers.

The final necessary condition is a proper legal and regulatory framework for supervision of insurance companies. Without proper supervision and in the case that insurance companies are subsidiaries or part of financial conglomerates, poor performance in insurance markets could negatively affect well-performing banks in the same holding company or conglomerate, and vice versa.

3.3 Experiences in Piloting New Products

Morocco

The World Bank, in collaboration with the International Food Research Institute, has conducted a study in Morocco to test rainfall-based insurance (See Skees et al., 2001, for a detailed description). Agriculture in Morocco accounts for almost 20% of the country's GDP and it is highly dependent on rainfall, less than 15% of arable area is irrigated. The government in turn has spent significant public resources in drought-related aid programs as well as bail-outs of financial institutions with large agricultural portfolios. The government has in place an area-yield insurance scheme but it is heavily subsidized and participation rates are low due to many program constraints. For example, indemnity payments are slow to reach policyholders and costly to administer, which acts as a deterrent to farmers to buy this insurance.

Table 3.

Aggregate Loss Ratios for Morocco			
year	**10% rainfall contract**	**Rainfall and area yield combined contract**	**2% Area yield contract**
1979	2%	0%	10%
1980	7%	8%	0%
1981	289%	281%	327%
1982	40%	35%	70%
1983	233%	140%	701%
1984	142%	170%	0%
1985	4%	5%	1%
1986	5%	6%	0%
1987	106%	101%	127%
1988	0%	0%	0%
1989	9%	10%	0%
1990	6%	6%	4%
1991	0%	0%	0%
1992	359%	398%	166%
1993	351%	383%	191%

1994	0%	0%	0%
1995	494%	496%	480%
1996	0%	0%	0%
1997	3%	0%	18%
1998	0%	0%	0%
1999	51%	61%	3%

Source: Skees et al. 2001

Statistical correlation between rainfall and cereal revenue in Morocco is sufficiently high, and pilot projects in various provinces are to be targeted in order to create various agro-climatic zones, diversifying the rainfall risk across regions and making reinsurance for such risk exposure more attractive.[4] Thus, the insurance contract will make payouts based on the shortfall of rainfall during a pre-specified period, and the contracts could be purchased for any coverage (amount), allowing farmers to insure the full amount of their expected revenue. The problem still faced by rainfall insurance contracts, or a combination of rainfall and area yield contracts, is the financing of indemnity payments. As can be seen in Table 3 above, there are some years where indemnity payments far exceed premiums collected (loss ratio is more than 100%), and when this even is repeated, the system can run into financial constraints. Nevertheless, this is still a superior solution than the area yield contract by itself.

Mongolia

In Mongolia new instruments are being tested, but to insure livestock deaths (Skees and Enkh, 2002a). Livestock mortality rates in Mongolia are highly correlated with severe weather during the winter season and the country has been performing livestock census every year. Due to weather-mortality correlation and reliable historical data, the livestock mortality rate index insurance contract will be based on the average livestock mortality rate of a given region. In turn, the insurance company providing such contracts can seek reinsurance for severe weather (such as prolonged temperature drops) covering the correlated risk component of the contract. As seen in Table 4 below, local clients chose mortality rate index insurance contracts over traditional and weather insurance.

Table 4.

[4] Cereal production is the most significant agricultural activity, occurring on about 70% of arable land.

Subjective Performance Assessments for Alternative Approaches in Mongolia			
Performance Goals	**Traditional Insurance**	**Weather Insurance**	**Mortality rate index insurance**
Insurance should not reward poor managers	Fails	Pass	Pass
Affordability for poor herders	No	Likely	Likely
Effective risk protection for individual herders	Fees, for most risky	In some cases	Most Likely
Focused on the most significant covariant risk	No	Likely	Likely
Sustainable & profitable for private companies	Highly unlikely	Likely	Likely
Fits with other forms of emergency aid	No	Likely	Likely
Low transaction costs	No	Likely	Likely
Acceptance from international risk sharing markets	Not likely	Likely	Likely
Opportunities for well defined government role	With great care	Likely	Likely
Source: Skees and Enkh, 2002a.			

The livestock mortality rate index insurance pays herders in the same region the same indemnity payments, so the incentive for individual herders to mitigate livestock losses not only is maintained, but it is reinforced by the competition among herders to survive the severe weather with lower than average livestock mortality rates. Mongolia has a relatively strong insurance and financial sector willing to supply such insurance services, but the challenge lies with the risk sharing mechanisms at the international level (reinsurance). Transferring the climatic risk abroad and pooling risks across Mongolia needs a minimum of government involvement and needs to be carefully combined with the necessary role of local private insurers. A couple of other concerns with the implementation of the new instruments are the moral hazard problem from the officials who develop the livestock mortality statistics and the ability to predict a bad year. For the first concern, the data collection process needs to be independent from outsider influence, and the second concern could be addressed with a multi-year insurance contract.

Mexico

Mexico has been at the frontier in terms of a developing country experimenting in the international weather reinsurance market. In 2001 AGROASEMEX was the first developing country that used weather derivatives to reinsure the crop insurance program in their country, which has now become an attraction not only for crop insurance but for individual (farmer) weather insurance contracts, the natural disaster relief fund (FONDEN) and the self-insurance mutual funds (FONDOS).

An innovative instrument that is being analyzed by AGROASEMEX is the introduction of rainfall index insurance contracts coupled to water rights for the agricultural sector under irrigation in Mexico. Even though volumetric water rights for irrigation exist in Mexico (which is already a great advance in relation to other countries), the volume allocated by these rights is rarely delivered. Decisions by the water authority in Mexico (CNA) on the allocation of water across irrigation districts is made year by year. What this produces is a great uncertainty for producers from planting season to planting season,

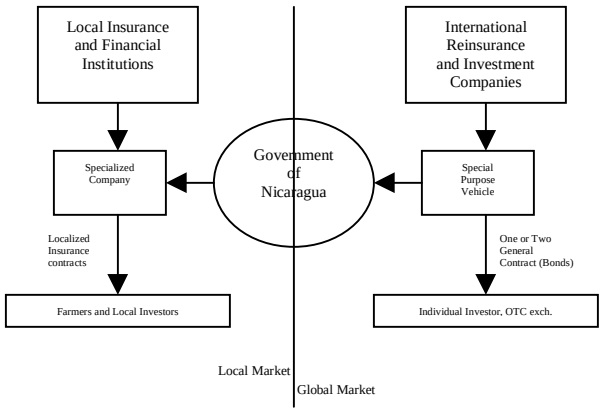
which inhibits them from planning production beyond the current planting season. This seasonal uncertainty created by CNA's yearly allocation decisions is due to the impossibility of accurately modeling reservoir water levels years in advance. Rainfall varies in such way that it is optimal for the CNA to optimize their water quotas every year.

However, if Water Authorities (WAs), such as the Water User Associations (WUAs), the Sociedades de Responsabilidad Limitada (SRLs), or the CNA, could transfer the rainfall risk away from its water allocation decisions, they could offer guarantees to farmers for several years or seasons. Rainfall insurance contracts could be purchased by can the WAs, so that it could offer farmers water rights with a guarantee that in the case of not being able to provide the minimum designated water volume, indemnity payment would be made. This would create certainty of water or income to farmers, allowing them to capitalize on their water rights fostering investments in their production systems. In this case the WAs would be the most efficient institutional level to target with the rainfall insurance contracts, as it is them who bear the management risk of water allocation and reservoir maintenance.

Nicaragua

In Nicaragua it is being proposed to create a similar sort of institution like AGROASEMEX to be under direct government supervision but in direct contract with reinsurance and international weather markets. The objective is to move from traditional insurance schemes, which are expensive to the country, directly to index-based contracts and a transfer of the systemic risk to the global market. Figure 1 shows the structure of such proposed agricultural insurance structure (Miranda and Vedenov, 2001).

Figure 1. A hypothetical institutional framework of agricultural risk management through market securitization.



Source: Miranda and Vedenov, 2001.

At the local level, the challenge to implement such innovative insurance instruments is manifold: (i) get reliable and accurate data for the index (be it area-yield or weather related); (ii) the lack of solid financial institutions; and (iii) the inexplicit nature of

disaster aid. On the other hand, the challenge for securitizing the systemic risk is the high transaction costs involved in the issuing of contingency securities to international markets or purchases of international weather derivatives or establishment of international reinsurance contracts. However, these high transaction costs of risk transferring for such index based insurance are still lower than the costs paid for transferring part of the risk of the less transparent traditional crop insurance instruments.

4. Conclusions

Traditional multiple peril agricultural insurance products, both in developed and developing countries, have been plagued with incentive problems (moral hazard and adverse selection), high administrative costs, and political interference in price setting. Programs in developed countries continue despite the high fiscal costs due to a greater ability to sustain the costs from higher levels of income and the relatively low number of agricultural producers in total population. In developing countries, the public treasuries do not enjoy the same ability to sustain costly programs and the number of agricultural producers is relatively much higher.

In the last 12-15 years, new insurance products that hold the promise of being more cost effective and at least eliminating moral hazard issues are emerging. Area-yield indices are working well in the US but not so well in Morocco. Weather-based indices are still in nascent stages of implementation and no solid performance data are available that would permit a rigorous evaluation. However, the best case of innovation, in the developing world seems to be Mexico. The principal lesson learned from the experience of developed countries, is not to replicate their expensive systems, rather to use their extensive knowledge in designing and implementing insurance programs that avoid the classic obstacles to an efficient delivery of agricultural insurance.

Bibliography

Agroasemex. 2002. "The Crop and Livestock Insurance in Mexico: Actual Status and Perspectives." November, www.agroasemex.gob.mx

Camara de Senadores de Uruguay. 2003. Presentacion antes de la Comission de Ganaderia, Agricultura y Pesca por una delegacion espanola sobre tema de seguros agrarios. 4 de abril.

Ehlrich, I. And Becker, G. 1972. "Market Insurance, Self-Insurance and Self-Protection." Journal of Political Economy. Vol.80 (1972). 632-648.

Entidad Estatal de Seguros Agrarios (ENESA). 2003. "El Sistema Espanol de Seguros Agrarios Cominados", Madrid, Spain.

Goodwin, Barry K. 2001. "Problems with Market Insurance in Agriculture." American Journal of Agricultural Economics." 83(3). August, 643-649.

Hazell, Peter; Pomareda, Carlos and Valdes, Alberto. 1986. "Crop Insurance for Agricultural Development." The John Hopkins University Press. Baltimore,

Hernandez Trujillo, Jose Manuel. 1997. "Evaluacion y Perspectivas de Desarrollo de los Fondos de Aseguramiento Agropecaruaio". Dept. de Economia, UAM-Azcapotzalco, Mexico.

Hogan, Andrew J. 1983. "Crop Credit Insurance and Technical Change in Agricultural Development: A Theoretical Analysis." The Journal of Risk and Insurance, Volume 50, Issue 1. March, 1983, 118-130.

Mahul, Oliver. 2001. "Optimal Insurance Against Climatic Experience." American Journal of Agriculture Economics. 83(3). August, 2001. 593-604.

Makki, Shiva. 2002. "Crop Insurance in the United States: Basic Issues, Performance, and Lessons for Developing Countries", Presentation at the Inter-American Development Bank on June 5, in Washington, D.C.

_____and Somwaru, Agapi. 2001. "Farmers' Participation in Crop Insurance Markets: Creating the Right Incentives." American Journal of Agriculture Economics. 83(3). August, 2001. 662-667.

Ray, P.K. 1967. "Agricultural Insurance: Principles and Organization and Application to Developing Countries." Pergamon Press. London,

Sarris, Alexander. 2002. "The Demand for Commodity Insurance by Developing Country Agricultural Producers: Theory and an Application to Cocoa in Ghana." World Bank Policy Research Working Paper 2887. September.

Skees, Jerry. 2003. "Drawing from Lessons Learned on Index Insurance to Consider Financing Famine Relief Efforts." Presentation at the Inter-American Development Bank, Washington, DC. February.

Skees, Jerry R. and Enkh-Amgalan, Ayurzana. 2002a. "Examining the Feasibility of Livestock Insurance in Mongolia." World Bank Policy Research Working Paper 2886. September.

Skees, Jerry; Young, C.Edwin; Schnepf, Randall; Lin, William. 1999. "Production and Price Impacts of US Crop Insurance Subsidies: Some Preliminary Results." 10th Federal Forecasters Conference. Washington, DC, June 24, .

Skees, Jerry; Varangis, Panos; Larson, Donald; and Siegel, Paul. 2002b. "Can Financial Markets be Tapped to Help Poor People Cope with Weather Risks?" World Bank Policy Research Working Paper Series.

Skees, Jerry; Gober, Stephanie; Varangis, Panos; Lester, Rodney and Kalavakonda, Vijay. "Developing Rainfall-Based Index Insurance in Morocco." World Bank Policy Research Working Paper 2577. April, 2001.

Skees, Jerry R. and Barnett, Barry J. "Conceptual and Practical Considerations for Sharing Catastrophic/Systemic Risks." Review of Agricultural Economics. 21: 424-441, 1999.

Slangen, Anthony. 2002. "Agricultural Insurance in Developing Countries: A Way Forward." International Conference: Agricultural Insurance and Income Guarantee. Madrid, May 13, 2002.

Wenner, Mark. 2002. "Lessons Learned in Rural Finance." Technical Papers Series, IADB-SDS. Washington, DC.

Zorrilla, José Luis. "Extensive Herbaceous Cultivation and Cattle Risks: Possibilities that Agricultural Insurance Offers for their Management." International Conference: Agricultural Insurance and Income Guarantee. Madrid, May 13, 2002.

Miranda, Mario and Vedenov, Dmitry V. "Innovations in Agricultural and Natural Disaster Insurance." American Journal of Agricultural Economics. 83(3): 650-655. August, 2001.